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ABSTRACT

Provided are the rationale, content and strategy for an introductory course in instructional design for special education teachers. The teacher's need for varied competencies in instructional design, management and interaction are discussed. It is recommended that teacher training include development of such design skills as task analysis, learner analysis, specifying objectives, constructing criterion-referenced tests, using formative evaluation to modify materials, and validating instructional materials. The course content is seen to include development of a programed instructional unit and mastery of other instructional packaging formats such as multimedia packages, materials with psychomotor or affective objectives, and managerial materials. Described are basic strategies for training instructional designers (such as modeling and editorial guidance), resource materials, and application of the Keller method of individualized self-study instruction. Two appendixes contain lists of behavioral objectives for competencies in programed instruction and readings for the instructional design course. (LH)

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Teaching the Handicapped

School of Education, Indiana University, Bloomington

THE SPECIAL EDUCATION TEACHER AS AN INSTRUCTIONAL DESIGNER

RATIONALE, CONTENT, AND STRATEGY FOR AN INNOVATIVE INDIVIDUALIZED COURSE ON INSTRUCTIONAL DESIGN IN SPECIAL EDUCATION

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Abstract

This paper provides the rationale, content, and strategy for a course on instructional design for special education teachers. The role of a special education teacher is rapidly changing to suit the demands of the real world and real time. This teacher has to have competencies in instructional interaction and instructional management. In addition, it is recommended that the teacher be equipped with the competencies of instructional design. The direct effects of such training will be the creation of instructional packages in an area where there is a virtual vacuum. It will also result in more sophisticated selection, evaluation, and utilization of existing instructional materials. Most importantly, training in instructional design will have a positive transfer to the teacher's classroom interactions. The content of this instructional design course will include such skills as task analysis, learner analysis, specifying objectives and entry behavior, constructing criterion-referenced tests, designing instructional sequences, modifying materials on the basis of formative evaluation, and validating instructional materials. The design and development of a programmed instructional unit will form

the introductory exposure to this field. In addition, the teacher-designer will be exposed to such areas as mediated instructional materials, materials with affective or psychomotor objectives, managerial materials, and interactional materials. The management of the course will involve the use of various textual resources, exemplars of instructional materials, model and protocol video tapes, editors, and tryout subjects. The course will be structured according to the Keller method with the self-pacing of learning, prespecification of objectives to be attained for different grades, availability of instructor-editors, encouragement of peer teaching, and criterion-referenced evaluation.

The paper also provides a complete set of objectives for the course and lists various resource materials. It reports on the field testing of such a course and recommends large-scale adoption of the course in special education teacher-training programs.

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A teacher's job defies definition. As Merrill (1971) points out, the teacher is a combination of an actor, audio-visual specialist, author, babysitter, bookkeeper, cashier, clerk, chaperon, counselor, companion, discussion leader, drama coach, judge, lecturer, measurement specialist, nurse, policeman, projectionist, referee, secretary, social worker, test proctor, and tour guide. More items can be added to this list when we attempt to specify the functions of a special education teacher. Fortunately, these functions can be clustered into a few major roles for the teacher.

The Traditional Role: Instructional Interactor

Traditionally, the teacher is seen at the front and center of the classroom, teaching the students. The competencies he is taught in a methods course reflect this: writing lesson plans, methods of presentation, lecturing, telling stories, questioning, probing, presenting examples, explaining, etc. Materials used by the teacher in this role are limited to texts and tests. Any audio-visual aid is merely added on, at the teacher's discretion, and always kept under his control.

It is evident that such a perception of the teacher's role is too narrow and outdated. This teacher could easily be replaced by machines

or media. His approach to teaching has no relevance to the realities of the classroom, particularly the special classroom. This teacher cannot cope with a situation that requires individualization.

The Emerging Role: Instructional Manager

Currently, the teacher's role is undergoing a slow but steady fundamental change from that of a practitioner of teaching to a manager of learning. The reasons for this change are many. The educational technology movement has become tired of playing second fiddle and has moved into conducting the orchestra itself. It has stopped preparing aids and begun creating total instructional systems. The move toward individually prescribed instruction under various brand names has brought about additional pressure to change the traditional image of the teacher. At the same time, subject-matter experts and curriculum committees are getting a piece of the action by preparing their own packages and prescribing how the teacher ought to manage them. The appearance of aides and paraprofessionals has added another dimension to the teacher's managerial role. Even the motivational aspects of teaching have been reduced to that of managing contingencies: keeping performance records and making payments of tokens and trinkets.

The functions of a teacher-manager include testing, diagnosing, and placing the learner; prescribing suitable mainstream or remedial instructional resources for the learner; identifying, evaluating, and organizing resource materials; providing the learner with appropriate learning materials, constantly monitoring the learner; and keeping track of the learner's place in the continua of objectives. Although this role is a

definite improvement upon the traditional teacher role, it still leaves some problems untouched. It is a false assumption, perhaps due to wishful thinking, that there exists a vast educational supermarket where the teacher-manager may order everything he needs. In reality, the fare is very limited, and what little is available is probably beyond the digestive powers of the exceptional child. In our attempts for over three years to locate instructional packages specifically designed for use by deaf children, we could find only four or five isolated items. When there is so little to manage, what is the teacher to do with his managerial skills?

The Neglected Role: Instructional Designer

Not too many people have suggested that the teacher could assume the role of an instructional designer. Actually, experts in the field seriously doubt whether or not instructional design competencies are within the capabilities of most teachers. Only Merrill (1971) has been bold enough to suggest this role and discuss appropriate training issues.

Instructional design is not to be confused with cut-and-paste techniques and media-utilization methods. True instructional design goes under a variety of names such as "instructional development," "systematic development of instruction," "instructional systems analysis," "programmed instructional process," "instructional-module development," "minicourse construction," and "educational technology." Instructional design skills include those of analyzing the instructional task and the characteristics of the handicapped student, constructing criterion-referenced tests, designing prototype units on the basis of these

analyses using currently available praxiological principles and appropriate media, modifying the materials on the basis of expert opinion and learner feedback, and demonstrating the effectiveness of the materials through summative evaluation.

The primary recommendation of this paper is that we should recognize the instructional-design role of the special education teacher and realize that these skills could and should form a part of teacher training. Such training is not meant to replace the education of the teacher as an interactor or a manager. This is merely a plea for adding a new component to teacher preparation. The advantages of this move are many:

1. There are not enough instructional packages specifically designed for exceptional children. Teacher-developed materials will help alleviate this shortage.

2. Teachers may use their instructional design skills to modify and adapt commercially available materials designed for a different population.

3. A well-known phenomenon in educational dissemination is that no outside material is totally acceptable to a classroom teacher. Rather than starting from scratch, teachers may now modify partially adequate materials for their classroom use.

4. A better understanding of how instructional materials are designed will make the teacher-manager a better judge of the quality of commercial materials. For example, after having tried out his own program on children and realizing the importance of this procedure, he will be looking for evidence of student testing in the materials which are sold to him.

5. Instructional design skills will help teacher-managers attain true individualization of instruction to a degree beyond mere management.

6. Teacher-designed materials will multiply the teacher's instructional effectiveness through the use of other human resources (advanced students, peer tutors, parents, and teacher aides) in the special classroom.

7. Teachers will retain the ultimate decision-making rights in their classrooms rather than being monitors for somebody else's materials.

8. Working in the instructional design field shifts teachers' focus from teaching to learning. It induces them to become empiricists. They may create materials incorporating different principles and test them under more controlled conditions than in the usual classroom settings. This will enable teachers to work out individual theories of instruction.

9. Most of the important benefits of instructional design training are its corollary effects on teachers' interactional strategies.

Effects of Instructional Design Training: Some Data

For the past four summers the author has conducted an in-service institute on instructional design for teachers of the deaf. Follow-up studies of the participants indicate promising long-range effects. Table 1 summarizes the percents of responses to relevant items in a post-institute questionnaire which was mailed out some nine months after the institute to all 32 participants of the 1970 institute. Thirty participants responded. Although the items refer to programmed instruction, because of our broad definition of the method, they are equally

TABLE 1

Post Institute Evaluation

Question	Percentage of people responding Yes	No	No response
1. Have you written any new programs?	37	63	---
2. Have you used commercial programs?	47	50	3
3. Have you used programs developed by other participants?	50	37	13
4. Does the school consult with you regarding PI materials?	73	17	10
5. Have you discussed PI with the school staff?	97	3	---
6. Have you taught programming to other school personnel?	47	53	---

applicable to any systematically developed, student tested instructional material.

Instructional design skills seem to linger with the teachers after they return to their classrooms. The fairly low percentage of those "writing" new programs is probably due to the fact that developing a program is a time-consuming job and not many of the teachers had any released time. Although no comparable figures are available, the reported 47% making use of commercial programs is felt to be higher than the figure for other teachers of the deaf. This figure is definitely higher than the 10% use reported by the participants before they underwent the training. The higher percentage of use of other teachers' programs than commercial ones indicates that teacher-designers find each other's materials more acceptable than commercial ones. A sizeable number of teachers consulted with the school on such matters as the purchase of programs for libraries. Almost all teachers shared their experiences with others and, in many cases, voluntarily taught instructional design skills to their colleagues.

More interesting than the direct effects of the instructional design course is its spill-over into the teachers' everyday classroom behaviors. Many teachers declared that the institute had a significant impact on their teaching style. "I'll never teach the same way again," was a frequent comment both during and after the institute. The following are some of the specific ways in which instructional design skills and principles have been reported to have changed their interactional behavior.

Task Analysis

Teacher-designers take a more critical look at the topics they teach and analyze them in terms of component subtasks. This enables them to derive a logical set of behavioral objectives rather than pull such objectives out of thin air in a disconnected fashion. They are also able to discriminate between valid objectives and trivial, irrelevant ones. Many teachers have begun writing their lesson plans in terms of performance objectives.

Learner Analysis

Teacher-designers look at their learners from an instructional point of view. They automatically check to see if all pupils have all prerequisite skills and knowledge before beginning a new lesson. They take into consideration individual and group characteristics, aptitudes, limitations, and entry behaviors in selecting suitable activities, media, and methods for their children.

Constructing Criterion Tests

Teachers construct tests to measure their instructional objectives systematically rather than try to "spread out" their students. There is also a fundamental shift in the way test scores are interpreted. They are seen more as feedback on deficiencies in instruction rather than reflections of lack of student achievement. Test results frequently result in a change in teaching styles. Individual student problems are diagnosed and suitable remedial instruction provided to help the student attain those objectives which he missed the first time around.

Sequencing Instruction

Teachers sequence their lessons as if they were sequencing them for a programmed unit. For example, in teaching a concept, they begin with a set of clear-cut examples, lead the students to discover the critical attributes of the concept, have them identify examples and non-examples in a new set and justify their choices, and so on. In teaching a multiple-discrimination task, they use suitable prompts and provide appropriate practice. In teaching procedural chains, teachers again use the sequencing strategies (e.g., backward chaining) they would use in the design of instructional materials.

Active Responding and Immediate Confirmation

Teachers are able to equate the undesirable "copy frames" of programmed instruction to the usual lower-level classroom questions. Frequency and level of teacher questions go up. Children are given frequent opportunities to make relevant responses and receive continuous reports of how well they are doing. Many lesson plans contain a series of criterion questions to form an outline. Tests are immediately scored, usually by the students themselves comparing their responses to a confirmation key. Instructional materials for the classroom are evaluated in terms of response requirements and the knowledge of results they provide.

Using Optimum Step Size

Training in instructional design makes teachers conscious of their instructional step size in relation to the capabilities of their students. Many have found out that they are using too large a step size;

some, too small. Teachers attempt systematically to identify the optimum step size by beginning with the "leanest" lesson and simplifying it until an efficient version is obtained.

Developmental Testing and Revision

Some teachers spotcheck with criterion questions in the middle of their lessons and make on-the-spot revisions in their presentation on the basis of a hand-raise feedback system they have worked out with their pupils. Teachers who teach the same subject to two different classes use the feedback from the first class to make appropriate modifications in their lessons before presentation to the second class. They try out instructional materials with a small set of individual students and modify them as necessary before using them on a larger scale.

All these applications of instructional-design skills to the classroom are collected from participant responses to a follow-up questionnaire. This transfer to instructional interaction in the classroom is totally spontaneous. Based on these comments and student suggestions, a unit is now being developed to incorporate a transfer component in the course which discusses ways of applying instructional-design principles to classroom teaching and provides a series of transfer exercises.

Content

If we agree on the benefits of training special education teachers in instructional design skills, the next logical question is, "What exactly do we teach them, and how do we teach them?" This section attempts to answer the first part of the question while the next section handles the second. What follows is based on a content analysis of edu-

cational technology literature and a performance analysis of successful instructional designers.

What is Instructional Design?

After the early years of controversy, there now seems to be considerable convergence as to the product of the instructional design. This product is defined by Markle (1967) as "a reproducible sequence of instructional events designed to produce a measurable and consistent effect on the behavior of each and every acceptable student [p. 104]." Lumsdaine (1964) defines it as "a vehicle which generates an essentially reproducible sequence of instructional events and accepts responsibility for efficiently accomplishing a specified change from a given range of initial competences or behavioral tendencies [p. 385]."

These and similar definitions share a number of critical attributes:

1. an implication of specific behavioral objectives ("measurable effect," "specified change to a specified terminal range of competences")

2. analysis and specification of learner characteristics ("every acceptable student," "from a given range of initial competences or behavioral tendencies")

3. accountability ("consistent effects," "accepts responsibility for efficiently accomplishing")

4. sequencing of instructional events

5. evidence of repeated student testing (reproducibility).

Further analyses of these definitions indicate that such factors as the format, media, exact nature of instructional events, and subject-matter areas are irrelevant to an instructional package.

What about the instructional-design process which will result in these products? According to Glaser (1966), the four essential components of this process are:

(a) analyzing the characteristics of the subject-matter competence,

(b) diagnosing preinstructional behavior,

(c) carrying out the instructional process, and

(d) measuring learning outcomes.

Corey (1967) lists the following as the necessary competences for instructional development:

> 1. Familiarity with the behaviors that constitute the objectives of the instruction.
> 2. Familiarity with the physical, scholastic, psychological, and social characteristics of the population to be instructed.
> 3. Competence in the analysis of gross behavioral objectives.
> 4. Knowledge of the unique characteristics of various types of instructional environments.
> 5. Competence in procuring and interpreting "feedback" on the consequences of the instruction [pp. 20-21].

On the basis of these suggestions and through observations of, and interviews with, instructional designers, the following are what the author believes to be specific behavioral objectives for an introductory course on instructional design for special education teachers:

1. Task analysis. The teacher-designer shall analyze a novel or familiar task, with or without the help of a subject-matter expert, into a set of subtasks which are necessary and sufficient for the performance of the task.

2. Learner analysis. The teacher-designer shall analyze the target-student group to identify the task-related entry behavior and aptitude,

limitations, and preferences for different instructional events, media, and language levels.

3. Specifying objectives and prerequisite skills. The teacher-designer shall specify the general and specific objectives for the materials he is developing. These objectives should contain a statement of student performance and include, if appropriate, a range for this performance, equipment and aids, performance standards, and a time limit. He shall also list the prerequisite entry behaviors and tool skills necessary to benefit from the instructional package to be developed.

4. Constructing criterion tests. The teacher-designer shall construct an entry test (for the diagnostic assessment of prerequisite entry behaviors), a pretest, and a posttest to accompany his instructional package. He shall also design a set of criterion items to be imbedded in the instructional package itself.

5. Designing the initial version. The teacher-designer shall design the initial version of his instructional package. This design should take into account his earlier task and learner analyses and incorporate currently available principles for sequencing different types of learning.

6. Formative evaluation. The instructional designer shall modify his package on the basis of expert opinion on the accuracy of subject matter, correctness of language usage, and appropriateness of instructional strategies. He shall also conduct individual tryouts of his material with representative students and further modify it on the basis of their responses and reactions.

7. Summative evaluation. The instructional designer shall conduct a validation test of his materials, collect relevant data, and prepare an evaluation report.

Programmed Instruction as a First Approximation of Instructional Design

Since the skills required of an instructional designer are many and varied, the question arises as to where one begins. The design of a paper-and-pencil programmed instructional unit is eminently suited for an initial exposure to instructional design. The advantages of beginning with programmed instruction are many:

1. Programmed instruction has come a long way since the days of funny-looking books with too many blanks. Current definitions of programs are not constrictive. Actually, both definitions of instructional products at the beginning of this section are present-day definitions of the term "program." Practice in the preparation of such programs will provide the teacher-designer with instructional-design skills and concepts which are generalizable to other media and formats.

2. One very essential skill (and an attitude) which the teacher-designer has to develop is that of repeatedly modifying the material on the basis of his own hindsight, expert opinion, and student feedback. In a paper-and-pencil program, such modifications can be done more easily and inexpensively than in any other medium.

3. In designing the frames of a program, the teacher-designer has assembled in one place all the elements of instructional design on a small scale: presenting information to the student, requiring a response from him, prompting him to the optimum degree, and providing him with

feedback and directions. In attempting more ambitious mediated modules, these elements are spread out so widely that it is hard for the teacher-designer to see the interrelationships between them.

4. Preparing a programmed unit permits the teacher-designer to explore various individualization strategies such as branching and by-pass paradigms at an uncomplicated level. After getting a feel for the merits and limitations of these adaptive techniques, the designer may more effectively use them on complex packages.

An analysis of an instructional programmer's performance yields a number of objectives. A subset of these, selected for initial training and for maximum generalizability to other instructional formats (Thiagarajan, 1971a), is listed in Appendix A.

Different Formats, Same Process

Training in instructional design begins with programmed instruction but does not end there: There are formats other than conventional programmed instruction and media other than the printed page. The next step, therefore, is to expose the teacher-designer to a wide variety of instructional packaging ideas to increase his repertoire of skills while stressing the commonality of the instructional-design process. Given below are various instructional formats to which the common design and development process from programmed instruction may be directly applied. These formats are also chosen for their relevance to exceptional children. After completing his introductory training in programmed instruction, the teacher-designer is ready to master the techniques associated with some or all of them.

I. Formats Using Other Media

1. Multimedia packages. These range in sophistication all the way from a simple slide-tape presentation to a complex, computer controlled happening. One of the essential skills involved in the production of such materials is ensuring that various media complement, rather than work against, each other (Thiagarajan & Sheppard, 1970; Fleming, 1970). Instructional packages of this type are extremely effective with affective objectives.

2. Audiotutorial approach. In this method, a series of instructional resources and activities are integrated and controlled by an audio tape (Postlethwaite, 1968). The child listens to the tape and interacts with the information given to him. The tape keeps him actively involved. It may have him respond in a workbook, look at visual materials while listening to the description, or even leave for some other location to perform an experiment. The audiotutorial approach will be particularly useful for topics in elementary science.

II. Formats Requiring Different Types of Task Analyses

3. Psychomotor instructional packages. These require specialized skills-analysis techniques including observation of master performers. The material has to provide suitable demonstrations and appropriate practice (Merrill, 1971; Davies, 1971).

4. Affective instructional packages. Creating instructional packages to help the learner attain affective objectives has only recently begun receiving attention among instructional designers. Such packages will be of great use with exceptional children, especially the emotionally

disturbed ones. Current techniques involve the use of broader restructuring of the environment, unobtrusive instructional devices, social-psychological principles, behavior modification, gestalt therapy, systematic desensitization, psychoanalysis, and the like (Thiagarajan, 1972).

III. Formats for Producing Adjunct Materials

5. Adjunct programming. This requires the use of available textbooks, films, and similar materials and the design and sequencing of a series of questions and exercises for response by the children either during or after initial learning (Pressey & Kinzer, 1964). Such instructional materials are more rapidly and inexpensively produced and enable the special education teacher to utilize materials designed for a "normal" population.

6. Teaching machines. A number of inexpensive, second-generation teaching machines (of mechanical or electrical nature) are now available. What is lost in restriction of instructional-design formats in these machines is compensated for by the ease of providing graded practice exercises for exceptional children. These machines come with flashing lights, buzzers, token dispensers, and other such devices for immediate feedback and reinforcement. However, a machine is only as good as the software inside it. This program has to be created by the teacher-designer with a careful control of difficulty levels and ingenious variety within the limitations of the machine. Systematic feeding of the machine will result in more efficient teaching of such "drill" areas as arithmetic operations and language patterns.

IV. Formats for Teacher-Independent Groups

7. Grouprograms. These are group-based instructional materials containing a series of discussion "frames" (Krishnamurty & Machiraju, 1972). Grouprograms permit the teacher-designer to utilize a wide variety of entry behaviors and experiences in a small group of children. When systematically designed, this format permits the use of a bigger step-size than the designer would normally dare and results in children teaching each other. Grouprograms may involve such techniques as role playing and are especially suited for teaching interpersonal skills.

8. Learning games. Games are ideal for exceptional children. They can be designed to simulate various events in real life and to help the children learn fairly complex interrelationships. Because they are designed to be played by children, games force the designer to make the activities specific and the concepts concrete enough to be translated into game moves. A number of techniques are available for designing, trying out, and modifying a learning game (Thiagarajan, 1971b).

V. Managerial Formats.

9. Keller method. This format involves placing a big share of the responsibility of instruction on the learner himself (Keller, 1968). The child is given a series of objectives or assignments, each of which has to be completed before moving on to the next. He is also shown different self-instructional resources suitable for his age. The child follows his own preferences and may learn from his peers. Accomplishment of each objective is verified by the teacher or an advanced learner. Combined with some form of contingency management, this method would be of great value to older exceptional children.

10. Programmed tutoring. This format involves utilizing untrained teacher aides, parents, and older children as tutors and has been found to be very successful in teaching basic skills to slow learners (Ellson, Harris, & Barber, 1968). In this format, instructional materials consist of two components. The content program contains all text materials and questions; the operational program specifies what the tutor is to do in presenting the content and reacting to the child's performance. By careful structuring of the materials, a small number of reusable operations is used to handle a wide variety of learner errors.

VI. Teacher Interactional Formats

11. Programmed presentations. This is an application of the principles of programmed instruction to classroom teaching (Deterline, 1967). The teacher-designer writes out his lesson plans in terms of behavioral objectives and sequences them as if he were designing an instructional package. During the actual lecture, he frequently asks questions, receives student responses, provides them with feedback, and modifies his presentation on the basis of the feedback from the children.

12. Concept-teaching kits. These are systematically assembled packages containing sets of examples, nonexamples, definitions, and questions for the teaching and testing of a concept. The accompanying script prescribes what the teacher is to do: present a set of clear-cut pairs containing examples and matched nonexamples, have the children find out which is which, provide them with complete and accurate feedback, and test them with novel examples and close-in nonexamples (Clark,

1971). The design of these kits involves analyzing the concepts, choosing appropriate examples and nonexamples, and applying various concept-teaching principles.

It is not likely that a single introductory course will provide the teacher-designer with an opportunity to master all the competences involved in all these instructional design formats. In the next section of this paper a strategy for permitting the student to sample and specialize in one or two of these variations is outlined.

Strategy

We now have the rationale and the content for an instructional design course for special education teachers. What remains to be done is to locate the resources and to devise the management strategy for the actual course.

How do People Become Instructional Designers?

Interviews with instructional designers suggest that the successful ones were trained (or educated) through a combination of four basic methods:

1. Background theory. Instructional designers have the relevant theoretical background of concepts, principles, and techniques derived from behavior psychology (and lately from other unusual sources). Successful designers tend to have an eclectic approach and a tendency to use anything which works with their students.

2. Modeling. Many instructional designers began by borrowing effective elements of different instructional packages and recombining

them to create an individual style. Many have packaged their content in the formats of successful materials.

3. Editorial guidance. Those who were fortunate enough to find an experienced, effective, friendly, and frank instructional designer had their initial versions slashed by him. Effective editorial teaching pinpoints exact deficiencies and offers specific suggestions for redesign. The modified material is repeatedly edited until both the material and its designer come up to the exacting standards of the master.

4. Cybernetic feedback. In this trial-and-error technique, the teacher-designer takes his crude version to the child and learns from him by following these recommendations from Gilbert (1960):

> Take your first crude effort to the student. Remember, he is going to teach you. This student cannot fail. If he doesn't get where you want him to go, you have failed. Try something else. In the absence of anything better, let him be your guide. If you come to a dead end, vary your approach until you have gotten him where you want him to go . . . The important thing to remember is to keep varying your behavior until you are successful and able to describe what you do [pp. 479-480].

Resources

Resources for Knowledge Base

These four learning approaches need different types of resources. Only recently have there been texts and collections of readings on instructional design. Merrill's (1971) collection of papers and DeCecco's (1968) educational psychology text use Glaser's outline of instructional design skills, given earlier, as their organizational framework. Popham and Baker (1970a, 1970b, 1970c) have produced a number of excellent texts in this area.

Other textual sources for the knowledge base are listed in the reading list in Appendix B. The basic text for the first part of the course is a programmed instructional text on the programming process. This text covers the objectives discussed in the previous section and guarantees their attainment through a series of transfer exercises which require the student to choose an instructional topic of his own, analyze it, and design and develop a programmed unit on it by taking it through the entire process. This text has been validated and reviewed (Sheppard, 1971) and has been field tested in a comparable course on instructional design for teachers of the deaf.

For the second part of the course where the teacher-designer tries his hand on other formats, a set of "how-to" manuals and articles were assembled and tried with success. These are also listed in Appendix B.

Resources for Modeling

The list of resources for knowledge base does double service by containing materials which can also serve as models for various instructional-design formats and techniques. For example, the list contains a programmed text on programming, an instructional game on game design, and a group-discussion program on group discussion programs. In addition, over the last three years, the author has assembled a collection of more than 100 teacher-designed instructional materials. Many of them are paper-and-pencil programs for exceptional children.

For the modeling of processes rather than products, a library of video tapes is being assembled to cover interpersonal aspects of instructional design: task analysis and editorial sessions with experts and

developmental testing with children. Expert instructional designers provide model tapes for imitation, and beginning teacher-designers provide protocols for evaluation.

Resources for Editorial Guidance

Rather than being run by a single teacher, this course will benefit from a team of instructor-editors consisting of at least one special educator and one instructional designer. Their major responsibilities will be to provide editorial guidance and technical help to the teacher-designers as they develop their materials. Effective editorial teaching requires that both the editor and the learner talk the same language. Rather than provide ambiguous and cryptic comments, the editors will have to go through a systematic process of demonstrating, prompting, and releasing the teacher-designer. The editors may have to begin by actually rewriting some material and later give specific instructions on what is to be done. Finally, they may merely point out what is wrong and leave it to the teacher-designer to rectify effectively.

All this takes a lot of time. To relieve the pressures on the instructor-editors, we have successfully utilized another editorial resource--the students themselves. Teacher-designers exchange their materials and edit each other's work. To the editor, this gives experience in objectively identifying various violations of instructional-design principles in some material other than his own. This objectivity may later transfer to his own material. Discrimination between good and bad frames is an essential first step for generating the good ones. The editor gets practice in this, too. The other person gets

editorial feedback from a non-anxiety-provoking, nonauthority figure.

Analogous to the editing of products is the expert feedback on interpersonal processes. We are currently designing an observation coding system to be used for recording and reporting interactions between the designer and the tryout student. This system will be found useful for expert, peer, and self-evaluation of the teacher-designer's interactive skills.

Resources for Student Tryouts

Each teacher-designer enrolled in the course is required to choose instructional topics relevant and usable in special classrooms. He is also responsible for making arrangements for testing his products with target students and utilizing their feedback. The instructors may help, but the teacher-designer has to plan ahead for a population of a suitable size for conducting extensive developmental testing.

Management of the Course

Keller Method

It would be almost sacrilegious to run this course on a traditional lecture format. A management strategy was implied in the earlier discussion of the content and resources. This strategy will be specified in greater detail now. It is based on what is being termed as the Keller method of individualized self-study instruction. The method has been found to be very efficient and motivating at the college level. It has also been tried out with the prototype of this instructional design course. Its main features follow.

1. Major responsibility for learning is with the learner himself.

2. The learner is provided with a set of objectives, ways of demonstrating the mastery of these objectives, and a list of resource materials.

3. The learner is given prespecified, criterion-based requirements for grades of A, B, and C. These are in terms of units of work to be successfully completed rather than in terms of test scores.

4. The course is self-paced. The learner may continue working on the course beyond the conventional semester period without any penalty. He may also complete the requirements of the course much earlier.

5. Mastery of each unit is required before the learner can proceed to the next one.

6. Extensive use is made of student monitors whose attainment of objectives has been checked by the instructor. These monitors check out other students.

7. Learner's performance in each unit is gauged on a pass/fail basis. The learner may attempt the same unit again any number of times.

Application of the Keller Method to the Instructional-Design Course

We may now impose the Keller method on the content and objectives of our instructional-design course. All learners will be required to go through the various units of the programming process and to complete a series of assignments at an acceptable level. Completion of these units will earn a grade of C. In addition, the learner may choose a unit and complete an assignment on instructional design using a dif-

ferent format for a grade of B, or two for a grade of A.

Specifically, for a grade of C, the teacher-designer shall complete all of the following assignments in the given order.

1. Choose a topic amenable to programming.
2. Perform a task analysis.
3. Perform a learner analysis.
4. Derive a set of objectives.
5. Construct criterion-referenced tests and diagnostic entry tests.
6. Design the initial version of the program.
7. Modify the program on the basis of editorial suggestions.
8. Test the program with children and revise it.
9. Prepare a proposal for validating the program.

For a grade of B, the teacher-designer shall also complete any <u>one</u> of the following assignments:

1. Perform analysis of a psychomotor task.
2. Perform analysis of an affective task.
3. Prepare an adjunct program to accompany a given lesson or film.
4. Prepare a series of practice frames for a teaching machine.
5. Write a lesson plan for a programmed presentation.
6. Design a Keller method management system for a unit of classwork.
7. Design a programmed-tutoring kit.

For a grade of A, the teacher-designer shall also design any <u>one</u> of the following packages:

1. An audio-visual package.
2. An audiotutorial package.

3. A learning game.

4. A program for group discussion.

5. A concept-teaching kit.

At the beginning of the course the learner will be given a set of objectives and a reading list keyed to these objectives. He may use any resource materials and consult with anybody. He may meet with the instructor-editors only if he wants to, but he should get his work checked by them for unit credit. A model schedule will be provided for the learner's guidance, although he need not stick to it. There will be some large-group orientation meetings for which attendance is compulsory. Meetings for screening of films are optional.

Summary and Conclusions

This paper has provided the rationale, content, and strategy for a course on instructional design for special education teachers. The role of a special education teacher is manifold and it is rapidly changing to suit the demands of the real world and real time. This teacher has to have competences in instructional interaction and instructional management. In addition, it is recommended that the teacher be equipped with the competences of designing instructional packages in an area where there is a virtual vacuum. It will also result in more sophisticated selection, evaluation, and utilization of existing instructional materials. Most importantly, training in instructional design will have a positive transfer to the teacher's classroom interactions. The content of this instructional design course will include such skills as task analysis, learner analysis, specifying objectives and entry

behavior, constructing criterion-referenced tests, designing instructional sequences, modifying materials on the basis of formative evaluation, and validating instructional materials. The design and development of a programmed instructional unit will form the introductory exposure to this field. In addition, the teacher-designer will be exposed to such areas as mediated instructional materials, materials with affective or psychomotor objectives, managerial materials, and interactional materials. The management of the course will involve the use of various textual resources, exemplars of instructional materials, model and protocol video tapes, editors, and tryout subjects. The course will be structured according to the Keller method with the self-pacing of learning, prespecification of objectives to be completed for different grades, availability of instructor-editors, encouragement of peer teaching, and criterion-referenced evaluation.

The task analysis for such a course has been completed; the objectives are specified and all resources are available. The course itself has been successfully field tested. It is ready to be exported and implemented in different locations.

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Merrill, M. D. (ed.) Instructional design: Readings. Englewood Cliffs, N. J.: Prentice Hall, 1971.

Popham, W. J., & Baker, E. L. Estabilshing instructional goals. Englewood Cliffs, N. J.: Prentice Hall, 1970(a).

Popham, W. J., & Baker, E. L. Planning an instructional sequence. Englewood Cliffs, N. J.: Prentice Hall, 1970(b).

Popham, W. J., & Baker, E. L. Systematic Instruction. Englewood Cliffs, N. J.: Prentice Hall, 1970(c).

Postlethwaite, S. N. An audio-tutorial approach to learning. Minneapolis: Burgess Publishing Company, 1968.

Pressey, S. L., & Kinzer, J. R. Auto-elucidation without programing. Psychology in the Schools, 1964, 1, 359-365.

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Thiagarajan, S. Design, development and validation of instructional games. Improving Human Performance, 1971(b), 10(10), 2-6.

Thiagarajan, S. Affective objectives, deaf learners and the programing process. Paper presented to the Symposium on Research and Utilization of Educational Media for Teaching the Deaf, Lincoln, Nebraska, April, 1972.

Thiagarajan, S., & Sheppard, A. N. Audiovisual programing. Paper presented at the Annual Convention of the National Society for Programed Instruction, Anaheim, California, April, 1970.

APPENDICES

Appendix A

Specific Behavioral Objectives

for Competences in Programmed Instruction

1. List the following five stages of the programming process in the correct order: task analysis, design, editing, developmental testing, and validation testing.

2. List the people involved in each stage of the programming process.

3. Name the products of each stage of the programming process.

4. Define programming as a process. The definition should include the concepts of specification of objectives, developmental testing, and validation testing.

5. Make a suitable statement of the main task.

6. Analyze the main task into simpler subtasks until the target student's entry behavior is reached.

7. Check the list of subtasks for completeness.

8. Locate and eliminate all unnecessary subtasks.

9. Locate and eliminate all trivial subtasks.

10. Discriminate between behavioral and nonbehavioral objectives; rewrite nonbehavioral objectives with a suitable performance term.

11. Given an incomplete objective, add a suitable range for student performance.

12. Given an incomplete objective, add a suitable statement about equipment and aids which are provided or denied to the student.

13. Given an incomplete objective, add suitable performance standards.

14. Given an incomplete objective, add a suitable time limit.

15. Write a complete set of specific objectives for a program on a topic of your own choice.

16. State the purpose for each of the following tests, their contents, and the time at which they are taken: entry test, pretest, and posttest.

17. Discriminate between entry test and pretest.

18. Given a statement of entry behavior, construct an entry test.

19. Given a set of subobjectives, construct three parallel test items for each of them.

20. Assemble these test items into pretest, posttest, and criterion-frame outline.

21. Recognize and give examples of the following types of learning tasks in your own subject-matter area: multiple discrimination, concepts, and chains.

22. Describe formal and thematic prompts and use them for teaching multiple-discrimination tasks.

23. List the sequence for teaching a concept; use this sequence in designing teaching frames for a concept.

24. Explain the demonstrate-prompt-release strategy for teaching chains and apply this strategy for the design of teaching frames.

25. Identify criterion frames with invalid questions.

26. Identify criterion frames with unsuitable question formats.

27. Identify criterion frames with excess information.

28. Check questions in teaching frames for relevancy.

29. Check questions in teaching frames for criticality.

30. Identify copying frames.

31. Identify the use of inappropriate information source.

32. Rewrite frames to eliminate these errors.

33. List three types of editing which the initial version of a program undergoes. This listing should be in an order which will avoid the need for repeating any type of editing.

34. State various methods for ensuring maximum feedback from editors.

35. List three different types of student feedback to be observed during developmental testing.

36. Describe verbally, or with the help of a rough sketch, the sequential arrangement of tests and revisions during developmental testing.

37. State the advantages of testing a long program in shorter segments and locate suitable stopping points on a given program.

38. State the need for using all adjunct material during developmental testing.

39. List the requirements of a student suitable for developmental testing.

40. List the requirements for the room in which developmental testing is to take place.

41. List student attitudes which may reduce feedback during developmental testing and suggest specific strategies to eliminate them.

42. List some useful questions for posttryout interview.

43. List four types of performance data to be gathered during validation testing.

44. List tests to be used during validation testing and briefly describe the purpose of each test.

45. List relevant student characteristics to be gathered at the beginning of validation testing.

46. Collect various test scores and report them in suitable format.

47. Collect information on time requirements and report it suitably.

48. Control the instructional situation suitably and report any special details.

Appendix B

Reading List

for the Course on Instructional Design

for Special Education Teachers

I. Basic text on programmed instruction and fundamentals of instructional design:

Thiagarajan, S. The programing process: A practical guide. Worthington, Ohio: Charles A. Jones Publishing Company, 1971.

II. General texts on instructional design:

American Institutes for Research. The technology for developing instructional materials. Pittsburgh, Pa.: American Institutes for Research, 1973.

Anderson, R. C., Faust, G. W., Roderick, M. C., Cunningham, D. J., & Andre, T. Current research on instruction. Englewood Cliffs, N. J.: Prentice-Hall, 1969.

Baker, R., & Schutz, R. E. Instructional product development. New York: Van Nostrand Reinholt Company, 1971.

Briggs, L. J. Handbook of procedures for the design of instruction. Pittsburgh, Pa.: American Institutes for Research, 1970.

Cavert, C. E. An approach to the design of mediated instruction. Washington, D. C.: AECT Publications, 1972.

Cavert, C. E. Procedural guidelines for the design of mediated instruction--a workbook. Washington, D. C.: AECT Publications, 1972.

Davies, I. K. Competency-based learning: Management technology and design. New York: McGraw-Hill, 1973.

DeCecco, J. P. (ed.) Educational technology, readings in programed instruction. New York: Holt, Rinehart and Winston, 1964.

Friesen, P. A. Designing instruction. Ottawa, Canada: Friesen, Kaye & Associates Ltd, 1971.

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Langdon, D. G. Interactive instructional designs for individualized learning. Englewood Cliffs, N. J.: Educational Technology Publications, 1973.

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Popham, W. J., & Baker, E. L. Systematic instruction. Englewood Cliffs, N. J.: Prentice-Hall, 1970.

III. Books and articles on various stages of the instructional-design process:

1. Task analysis:

Harless, J. H. An ounce of analysis. Falls Church, Va.: Harless Educational Technologists, 1971.

2. Learner analysis:

Gagne, R. M. (ed.) Learning and individual differences. Columbus, Ohio: Charles E. Merrill, 1967.

3. Specifying objectives:

Mager, R. Preparing instructional objectives. Palo Alto, Cal.: Fearon Publishers, 1962.

4. Test construction:

Popham, W. J. Criterion-referenced testing: An introduction. Englewood Cliffs, N. J.: Educational Technology Publishers, 1971.

5. Designing the initial version:

Bullock, D. H., & Wilson V. Creating programs for self-instruction. Washington, D. C.: Center for Educational Technology, Catholic University of America, 1972.

Markle, S. M. Good frames and bad: A grammar of frame writing. Second edition. New York: John Wiley, 1969.

6. Editing instructional materials:

Bullock, D. H., & Wilson, V. Editing and revising programs for self-instruction. Washington, D. C.: Center for Educational Technology, Catholic University of America, 1972.

7. Developmental testing:

Horn, R. Developmental testi Ann Arbor, Mich.: Center for Programed Learning for Business, 1966.

Markle, S. M. Empirical testing of programs. In P. C. Lange (ed.) Programed instruction. Sixty-sixth yearbook of the National Society for the Study of Education. Chicago, Illinois: Distributed by the University of Chicago Press, 1967.

8. Validation testing:

Jacobs, P. I., Maier, M., & Stolurow, L. M. A guide to evaluating self-instructional programs. New York: Holt, Rinehart and Winston, 1967.

IV. Books and articles on different formats for instructional design:

1. Audiovisual programs:

Fleming, M. L. Perceptual principles for the design of instructional materials. Viewpoints, 1970, 46(4), 69-200.

Thiagarajan, S., & Sheppard, A. N. Audiovisual programing. Paper presented at the Annual Convention of the National Society for Programed Instruction, Anaheim, California, April 1970.

2. Audio tutorial approach:

Postelthwaite, S. N. An audio-tutorial approach to learning. Minneapolis, Minn.: Burgess Publishing Company, 1968.

3. Materials for psychomotor objectives:

Davies, I. K. Teaching psychomotor skills. In The management of learning. London. McGraw-Hill, 1971.

Merrill, M. D. Paradigms for psychomotor instruction. In M. D. Merrill (ed.) Instructional design: Readings. Englewood Cliffs, N. J.: Prentice-Hall, 1971.

4. Materials for affective objectives:

Harless, J. H., & Lineberry, C. S. Turning kids on and off. Springfield, Va.: Guild V Publications, 1971.

Thiagarajan, S. Programed instruction in the affective domain. NSPI Journal, 1971, 10(6), 5-10.

Thiagarajan, S. Affective objectives, deaf learners and the programing process. Paper presented to the Symposium on Research and Utilization of Educational Media for Teaching the Deaf, Lincoln, Nebraska, April 1972.

Zimbardo, P., & Ebbesen, E. B. Influencing attitudes and changing behaviors. Reading, Mass.: Addison-Wesley Publishing Company, 1969.

5. Adjunct programing:

Pressey, S. L., & Kinzer, J. R. Auto-elucidation without programing. Psychology in the Schools, 1964, 1, 359-365.

6. Teaching machines:

Gotkin, L. G., & McSweeny, J. F. Learning from teaching machines. In P. C. Lange (ed.) Programed instruction. Sixty-sixth yearbook of the National Society for the Study of Education, Part II. Chicago: Distributed by the University of Chicago Press, 1967.

7. Group discussion material:

Krishnamurty, G. B., & Machiraju, N. R. Techniques of group-programing. Presented at the Annual Convention of the National Society for Programed Instruction, New Orleans, March 1972.

Thiagarajan, S. An introduction to grouprograms. Presented at the Annual Convention of the National Society for Programed Instruction, Washington, D. C., April 1969.

Thiagarajan, S., Sheppard, A., Newberger, H., Babick, A., & Russell, J. Programing the human component in an instructional system. British Journal of Educational Technology, 1971, 2(2), 143-152.

8. Learning games and simulation:

Gordon, R. A. Games for growth. Chicago: Science Research Associates, 1971.

Thiagarajan, S. Design, development and validation of instructional games. Improving Human Performance, 1971, 10(10), 2-6.

Thiagarajan, S. The GAMEgame. (A simulation game on learning games.) Bloomington, Ind.: Center for Innovation in Teaching the Handicapped, 1972.

9. Keller method:

Keller, F. S. Goodbye teacher . . . Journal of Applied Behavior Analysis, 1968, 1(1), 79-89.

10. Programmed tutoring:

Ellson, D. G., Barber, L. W., Harris, P. L., & Adams, R. B. Ginn tutorial tutor's guide. Boston: Ginn, 1968.

Ellson, D. G., Harris, P. L., & Barber, L. W. A field test of programed and directed tutoring. Reading Research Quarterly, 1968, #(3), 307-367.

Thiagarajan, S. Programed tutoring: A fresh look at the technique. Bloomington, Ind.: Center for Innovation in Teaching the Handicapped, 1971.

11. Concept-teaching kits:

Clark, D. C. Teaching concepts in the classroom: A set of teaching prescriptions derived from experimental research. Journal of Educational Psychology, 1971, 62(3), 253-278.

Thiagarajan, S. Concepts in the classroom. Bloomington, Ind.: Laboratory for Educational Development, 1970.

Thiagarajan, S. Naked monsters. (A learning game on concept-teaching skills.) Bloomington, Ind.: Center for Innovation in Teaching the Handicapped, 1972.

12. Programmed presentations:

Deterline, W. A. Practical problems in program production. In P. C. Lange (ed.) Programed instruction. Sixty-sixth yearbook of the National Society for the Study of Education. Chicago: Distributed by the University of Chicago Press, 1967.

Wark, D. M. The carousel lecture format. NSPI Journal, 1965, 4(5), 16.